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L. O. HOWARD, Chief

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THE CHICKEN MITE:[1] ITS LIFE HISTORY AND HABITS.

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In the present bulletin no attempt has been made to give an exhaustive study of the life history of the chicken mite; rather the aim has been to work out the main points in the life cycle of this pest and to discover principles upon which combative[2] measures may be based.[3]

REARING METHODS USED IN LIFE-HISTORY EXPERIMENTS.

The method of feeding the mites was simple. A large earthen jar, in which a small roost was put, was utilized for a breeding cage. The jar was set in a pan of water in order to prevent the escape of the mites, and a coarse-mesh wire screen was fastened over the top to hold the chicken in the jar. When it was desired to feed the mites they were either dropped in the bottom of the jar or else put on the fowl's back. Easy access was thus obtained to the host, and seldom if ever were hungry mites seen in the jar after being one night with the chicken. Sheets of paper were put in the bottom of the jar to collect the manure and some of the mites. Most of the fed mites were found about the roost in cracks prepared for them.

[1] *Dermanyssus gallinae* Redi.

[2] See Farmer's Bulletin No. 801, United States Department of Agriculture.

[3] To Mr. F. C. Bishopp the writer wishes to express appreciation for direction and helpful suggestions obtained in the course of the work.

Molting, mating, and deposition took place in tubes or small vials. In case individuals were being watched, vials were used, and where many mites were confined, test tubes were used. The vials were plugged with absorbent cotton covered with a small piece of black cloth. Black cloth was used because, owing to the contrast in color, it was much easier to observe the small white eggs and larvæ. The test tubes were plugged with cotton covered with white cheesecloth. No moisture or food of any sort was added to the tubes.

In the longevity experiments varied conditions were supplied. Some of the mites were kept in tubes on moist sand, others were kept in dry tubes, and others were on roosts. In the longevity experiment, in which the mites were supplied with a hen's egg, the egg was in a lantern chimney, both ends of which were covered with a piece of black cloth.

LIFE HISTORY.

THE EGG.

In appearance the egg of the mite is a small, oval, smooth, pearly white, and somewhat iridescent object (Pl. I). Ten eggs measured showed a maximum length of 387 microns, a minimum of 373 microns, a maximum width of 265.5 microns, and a minimum width of 244 microns, the average length being 379.3 microns and the average width 255.65 microns.

Incubation during the latter part of August took place in about 48 hours. The average mean temperature at this time was 78.43° F.

THE LARVA.

The young larva (Pl. I) on hatching is white and has only three pairs of legs. At the rear of the abdomen is a small protuberance which does not appear on any other stage. The larva moves about slowly, unlike the other stages, which are very active. The length and width of the larval body measure practically the same as those of the eggs. Without ever having fed, the larvæ molt to nymphs. Molting takes place in about 24.5 hours after hatching, when the average mean temperature is 73.5° F.

THE FIRST-STAGE NYMPH.

The young nymph (Pl. I) backs out of its larval skin like a person drawing his hand out of a tight glove. It has now acquired another pair of legs, making four pairs. After a few hours of resting, to give time for the body integument to harden, it becomes very active and will now feed if given a chance. The first-stage nymph is slightly darker in color than the larva, having a brownish tinge.

With its long, piercing mouth parts the nymph sucks the blood of the fowl. It crawls from the fowl onto the roost when fully

engorged, and is now bright red, owing to the ingested blood showing through the skin. The measurements of the mite (average of five) at this stage are: Length, 568 microns (abdomen only); width, 338.4 microns; thickness (average of three), 266 microns. After a period of somewhat less than 24 hours the first-stage nymph molts to the second stage. The average mean temperature during the period when the molting was observed was 82.9° F.

THE SECOND-STAGE NYMPH.

The second-stage nymph, like the preceding stage, requires a short period of rest to harden the integument. As soon as the nymph becomes active it is ready to feed. Some authors have said that the mite takes long periods of rest. The writer finds that when such rest periods are taken it is from force of circumstances and not from desire on the part of the mite. The mite before feeding measures (average of four) 538.2 microns in length and 297.9 microns in width. After feeding, the mite measures 751.9 microns in length by 461.4 microns in width (average of 10). The second-stage nymphs molt to adults (fig. 1). This is the rule, although there may be some nymphs which undergo an additional molt before reaching the adult stage. The writer found one mite which apparently had three nymphal stages. A single instance, however, can hardly be accepted as sufficient evidence for making an exception to the rule.

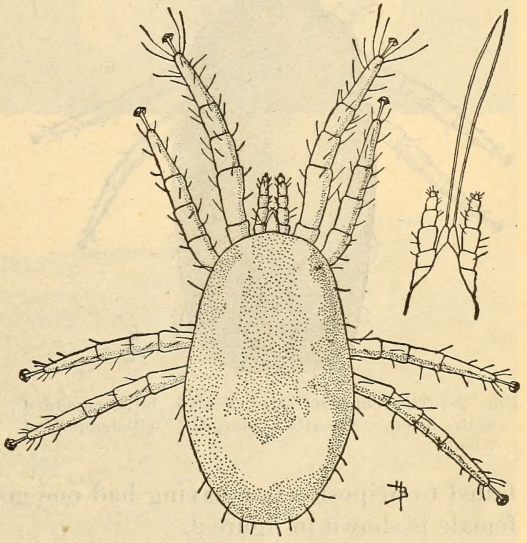


FIG. 1.—The chicken mite (*Dermanyssus gallinae*): Female mite before engorgement. Greatly enlarged. (Bishopp and Wood.)

THE ADULT.

As soon as the males crawl out of their nymphal skin they rest a short time, and are then ready to reproduce. They may clasp a nymph if no females have yet appeared, but as soon as a female appears a male will find her and clasp her, the venter of the female in close contact with the venter of the male. It is certain that

fertilization can take place soon after molting and before feeding, and it can take place also after feeding. Directly after molting the females will feed, but the males will not. No doubt each male is able to fertilize several females, so that immediately after molting this is all the male desires. Normally fertilization takes place off the host, though it is conceivable that occasionally it may take place on the host. The females begin depositing eggs within about 12 hours after feeding. They will feed and deposit fertile eggs repeatedly with only one fertilization. Under observation this was done eight times. No doubt under natural conditions these females would have been visited by males several times. A single feeding during warm weather is all that is necessary for each deposition. A very small number of mites failed to oviposit after having had one good feeding. An engorged female is shown in figure 2.

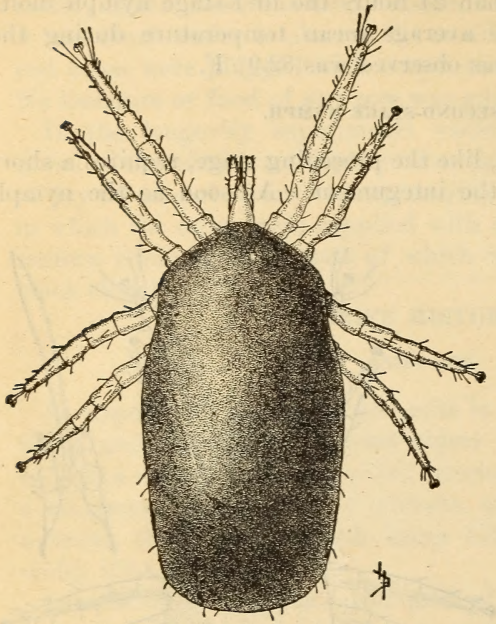


FIG. 2.—The chicken mite: Female mite engorged with blood. Greatly enlarged. (Bishopp and Wood.)

LIFE-CYCLE EXPERIMENTS.

The following outline gives an accurate record of the life cycle as worked out at Dallas, Tex.:

First-stage nymph engorgement:

August 6, 6 p. m. Several hundred first-stage nymphs put in jar with fowl.

August 7, 9 a. m. 542 engorged first-stage nymphs recovered.

First-stage nymph molting:

August 8, 7.30 a. m. Many have molted to second-stage nymphs.

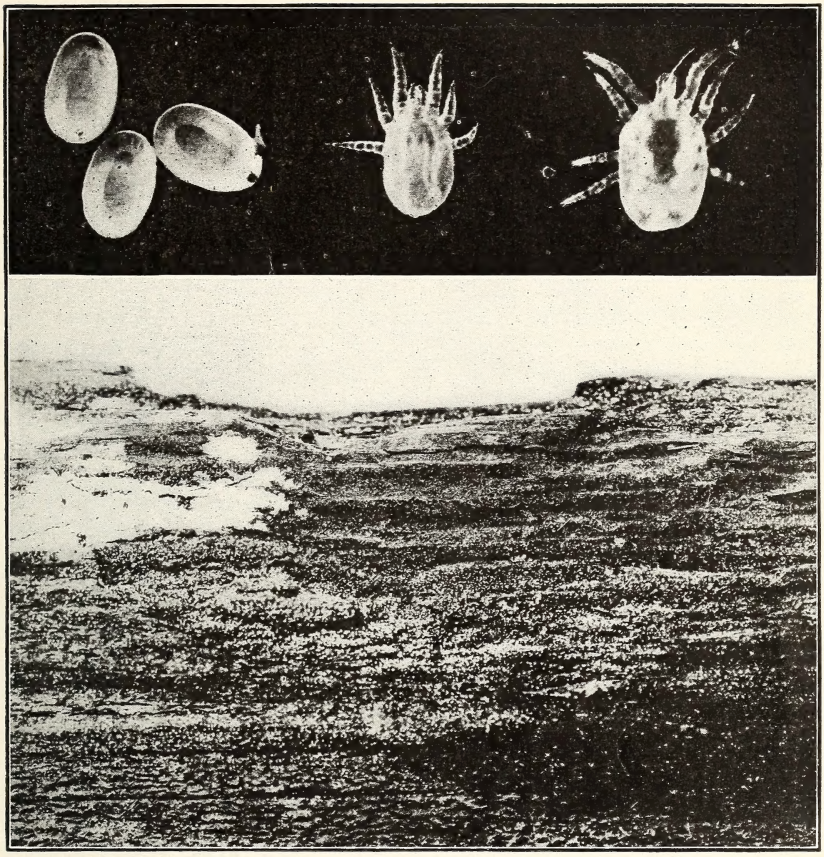
Second-stage nymph engorgement:

August 9, 5.30 p. m. All the second-stage nymphs (perhaps 50 of the 542 died) put in jar with chicken. The nymphs are very active.

August 10, 9 a. m. 263 engorged nymphs recovered.

Second-stage nymph molting and mating:

August 11, 9 a. m. Many have molted. Several pairs found to be in position of copulation.



THE CHICKEN MITE (DERMANYSSUS GALLINAE).

Upper left, eggs; upper center, larva, dorsal view; upper right, first-stage nymph before feeding; below, old roost showing spots of excrement. All much enlarged except the lower figure, which is somewhat reduced. (Original.)

First engorgement of females:

August 12, p. m. Put foregoing mites with fowl over night.

August 13, 9 a. m. 70 engorged females recovered, and about 30 unfed males. Females put in separate tubes from the males and one female in a tube.

First deposition of females:

August 13, 7 p. m. (before). Two females have begun to deposit.

August 14, 9 a .m. Five females are now depositing.

August 14, 9 a. m. Five females are now depositing.

August 15, 8.30 a. m. 52 females are now depositing.

August 15, 1.30 p. m. 61 females are now depositing.

August 15, 5 p. m. Same.

August 16, 10.30 a. m. 62 females are now depositing.

August 16, 4 p. m. 64 females are now depositing.

Hatching of eggs to larvæ:

August 16, 10.30 a. m. Some eggs from 17 of the females have hatched.

August 17, 11 a. m. 40 females now have eggs hatching.

August 17, 4 p. m. 43 females now have eggs hatching.

August 18, 10 a. m. 48 females now have eggs hatching.

(Sixteen females unaccounted for in notes.)

Molting of larvæ to first-stage nymphs:

August 16, 10.30 a. m. Some of one female's larval progeny have molted to first-stage nymphs.

August 17, 11 a. m. Some of 34 females' larval progeny now have molted to nymphs.

August 17, 5 p. m. Some of 42 females' larval progeny now have molted to nymphs.

August 18. Some of 57 females' larval progeny now have molted to nymphs.

Second engorgement of females:

(No males put with females before, during, or after feeding.)

August 20 (night of). About 60 females put with fowl.

August 21, 9 a. m. 59 engorged females recovered and put in separate vials, except seven which were not fully fed.

Second deposition:

August 22, 5 p. m.—

6 females have laid 1 egg each.
5 females have laid 2 eggs each.
24 females have laid 3 eggs each.
10 females have laid 4 eggs each.
6 females have laid 5 eggs each.
2 females have laid 6 eggs each.

August 23, 9.30 a. m.—

6 females have laid 1 egg each.
4 females have laid 2 eggs each.
10 females have laid 3 eggs each.
15 females have laid 4 eggs each.
11 females have laid 5 eggs each.
5 females have laid 6 eggs each.
2 females have laid 7 eggs each.

Totals, 53 females deposited 203 eggs.

The average mean temperature during this period was 80.8° F. No more eggs were deposited by these females until they were fed again. Two of the mites died after this deposition.

Hatching and larva molting from second deposition:

On August 23, 10 a. m., 13 eggs of this lot had hatched and one of the larvæ already had molted to a nymph. On August 24, 3 p. m., 178 eggs had hatched, and 66 of the resulting larvæ had molted. August 25, 2 p. m., all but four eggs had hatched, and 167 of the larvæ had transformed to nymphs. The following day only three eggs remained unhatched, and 190 of the 200 larvæ hatched had become nymphs.

Third engorgement:

August 26, 5 p. m., 51 females were put on a fowl for their third feeding; 49 of these were recovered on the following morning. All of these were engorged except one.

Third deposition:

Three of these females had begun depositing at 11 a. m., August 27. During the afternoon, night, and following day deposition proceeded freely. All but eight of the females had begun depositing at 5 p. m., August 27. All except 25 had completed deposition at 7 p. m., August 28. Only one egg was found after 4 p. m., August 29. It will be seen that deposition began approximately 18 hours after the mites were placed on the host and that practically all the eggs were deposited during the two days following the night of engorgement. The average mean temperature during this period was 78.43° F.

Hatching and larval molting from third deposition:

Two of these eggs had hatched by 8 a. m., August 29. All of those which completed incubation had hatched by 3 p. m. on August 31 except one, which hatched prior to 2.30 p. m. the following day. All but three eggs hatched, or slightly less than 1.3 per cent.

In a series of 10 eggs of the foregoing lot deposited between 2 and 4 p. m., August 27, six hatched between 8 a. m. and 3 p. m., August 29. Two others hatched during the next hour, and all were hatched at 10 the following morning. In another series of ten eggs deposited on August 27, the incubation period ranged from 45 to 49 hours, with an average of slightly less than 48 hours. During this period the average daily mean temperature was 78.43° F.

Molting of the larvæ which hatched on August 29 to September 1 from the eggs of the third deposition began on August 30, at 10 a. m., and was complete, with the exception of one individual, at 4 p. m., on September 2. The molting of the 10 larvæ hatched on August 29 was observed and ranged from 19 to 28 hours, with an average of 24.5 hours.

Fourth engorgement and deposition:

On the evening of September 3 the 46 remaining females were placed with a fowl for their fourth feeding. Thirty-five engorged females were recovered the following morning. On September 6 deposition was completed by all but two females. On September 8 all had finished depositing. One died without ovipositing, and three died soon after deposition was complete.

Fifth engorgement and deposition:

The remaining 32 females were put on a host for the fifth time on the evening of September 8. No males had been with them since previous to the first feeding. On September 9 22 engorged females were recovered, and all but two deposited—one of these died.

Sixth engorgement and deposition:

The sixth engorgement of the 20 females was made during the night of September 13. Fifteen of these were found engorged the following morning. Of these, three failed to deposit eggs. One of these three died.

Seventh engorgement and deposition:

During the night of September 17 12 females were placed with a host and 10 recovered. Seven of these deposited, one of the other three died, and one died soon after deposition.

Eighth engorgement and deposition:

The eighth engorgement was made during the night of September 22. All of the eight females applied to the host were engorged. Six of these deposited, beginning September 23 and finishing September 26. One female died without depositing and one failed to deposit.

On September 28, 100 per cent of the eggs deposited following the eighth engorgement had reached the nymphal stage, thus showing that fertility persisted though males were not with them since prior to the first feeding.

Ninth engorgement:

On September 28 the seven remaining females were put on a host for the ninth engorgement, but as only one was recovered the following morning the experiment was discontinued.

A summary of the depositions, with the number of eggs deposited by each female, is given in Table I.

TABLE I.—*Summary of oviposition records of Dermanyssus gallinae, Dallas, Tex., 1916.*

Depositions.	Number of females depositing 0 to 8 eggs each.									Total number of eggs.	Average per female.	Number of females depositing.	Number of females engorged.
	0	1	2	3	4	5	6	7	8				
First[1]													
Second	0	6	4	11	14	11	4	3	0	203	3.8	53	53
Third	1	2	1	2	11	14	11	7	0	239	4.98	48	49
Fourth	2	0	2	3	10	6	9	1	2	160	4.84	33	35
Fifth	2	0	0	4	5	5	5	1	0	94	4.7	20	22
Sixth	3	1	0	5	2	1	2	1	0	48	4.0	12	15
Seventh	3	0	4	1	0	1	1	0	0	22	3.14	7	10
Eighth	2	0	1	1	2	1	0	1	0	25	4.16	6	8

[1] Not recorded.

DISCUSSION OF RESULTS OF LIFE-CYCLE EXPERIMENTS.

No attempt was made in the experiment to see how quickly the life cycle could be accomplished. In the foregoing experiment the actual time taken for the mite to pass through its life stages was 10 days. Under natural conditions in August without doubt this time would be reduced to at least $8\frac{1}{2}$ days. Tables II and III show in brief the actual time taken in the experiment and the probable time in nature.

TABLE II—*Actual time taken by the mite (Dermanyssus gallinae) in experiment to go through life cycle.*

Date.	Hour.	Day.	Stage of development.
Aug. 6	9 p. m.	1	First-stage nymphs fed on fowl.
	9 a. m.		First-stage nymphs are all fed.
7	9 p. m.	2	Second-stage nymphs molted from first-stage nymphs.
	9 a. m.		
8	9 p. m.	3	
	9 a. m.		
9	9 p. m.	4	Second-stage nymphs fed on fowl.
	9 a. m.		Second-stage nymphs recovered fully fed.
10	9 p. m.	5	Adults have molted from second-stage nymphs.
	9 a. m.		
11	9 p. m.	6	
	9 a. m.		
12	9 p. m.	7	Females fed on fowl.
	9 a. m.		Females fully fed recovered.
13	9 p. m.	8	Eggs being deposited.
	9 a. m.		
14	9 p. m.	9	
	9 a. m.		
15	9 p. m.	10	Some eggs still being deposited.
	9 a. m.		Some eggs have begun to hatch to larvæ.
16	9 p. m.	11	Larvæ have begun to molt to first-stage nymphs.

TABLE III—*Probable time in nature the mite (Dermanyssus gallinae) takes to go through life cycle.*

Day.	Hour.	Stage of development.
First	a. m.	Eggs laid.
	p. m.	
Second	a. m.	
	p. m.	
Third	a. m.	Eggs hatched to larvæ.
	p. m.	
Fourth	a. m.	Larvæ molt to first-stage nymphs.
	p. m.	First-stage nymphs feed.
Fifth	a. m.	
	p. m.	First-stage nymphs are molted to second-stage nymphs.
Sixth	a.m	
	p. m.	Second-stage nymphs feed.
Seventh	a. m.	
	p. m.	Second-stage nymphs molt to adults.
Eighth	a. m.	
	p. m.	Females feed.
Ninth	a. m.	Eggs laid.

The average rate of deposition is about four eggs per day; that is, one egg in about 6.4 hours.

The rapidity with which the mite may reproduce is amazing. The possible progeny of one female in five weeks is conservatively estimated at 1,631 individuals, or, considering the duration of life of a female as eight weeks, her progeny would total 2,609 mites.

LONGEVITY.

As might be expected, since it feeds often and ordinarily does not have to wait long for a host, as do many of the ticks, the mite lives a comparatively short time in the absence of food. The experiments indicate that a certain amount of moisture and moderate temperature favor longevity, while extreme dryness and high temperatures are unfavorable factors. The mites die off much faster in the absence of food during the hot summer months than they do during the

winter. The lowest temperature experienced by any of the mites under observation was 15° F., the highest 97.5° F. Adults and second-stage nymphs, during the months of July, August, September, and October, lived longest when moisture was applied—from 91 to 98 days. Under dry conditions the mites lived 56 to 85 days. During the months of August, September, October, November, and December mites under dry conditions lived from 100 to 108 days. The longest that adults which had never fed as adults lived was from 88 to 96 days; this was during the months of October, November, December, and January. All stages on a stick of wood lived 91 to 113 days in the months of September to January, inclusive. All stages in a glass chimney with a cracked egg lived more than 107 days during the same months.

First-stage nymphs have about the same period of longevity as the other stages. During the months of July to November, inclusive, this stage, when moisture was added, exhibited a longevity of 81 days under both moist and dry conditions. Second-stage nymphs seem to be the longest lived. During the months of September to January, inclusive, individuals in this stage lived 139 days. Females which had completed oviposition lived from 29 to 39 days during September and October, when kept under dry conditions. Females feeding and depositing continuously live longer than those not allowed so to feed and deposit. In the life-cycle experiment some females lived longer than 53 days.

One may therefore conclude that the mite can be starved out of a chicken house by keeping fowls and other animals away from the house for four months during the summer season and five months during the cooler season. It is probable that with uniformly cold weather, as in the Northern States, the longevity would be somewhat greater than in these experiments, all of which were conducted at Dallas, Tex.

FEEDING AND HIDING HABITS OF MITES.

FEEDING HABITS.

The usual habit of the mite is to feed at night. An experiment was conducted to determine whether mites feed and leave the fowl immediately or whether they have a particular time for dropping, such as just before daylight, as one writer claims. Two hours before dark a fowl was put on a roost containing a large number of hungry mites. Very few mites ventured far out of their hiding places at this time. A few did go to the fowl. At dark, two hours later, only four mites were found to have fed and left the fowl. One hour after dark nearly 600 mites (adults and first and second stage nymphs) had fed and left the fowl. One and a quarter hours later 535 more fed mites left the bird. Mites continued to drop in smaller numbers until after

daylight. The writer finds that normal feeding takes place during the hours of darkness and that mites leave the fowl soon after feeding. All stages of mites will go on a fowl, feed, and leave it in less than two hours. In another experiment from 20 minutes to one-half hour was found to be sufficient time for complete engorgement. In one experiment about 30 per cent of a large number of mites put on a fowl in an earthen jar at 10 a. m. were full fed when observed at 2 p. m. The fact that some mites will feed day or night accounts in part for their very rapid increase about a sitting hen.

Though mites feed at night, they do not necessarily all crawl off the host before the fowls leave the roost. Both fed and unfed mites may be retained in the feathers when the fowls are running about. The number of such mites on a fowl seems to be small, but quite sufficient to infest a new place. The length of time mites may remain on a fowl after it has been on an infested roost is not certain. Experiments designed to throw some light on this point developed that nearly all mites leave the fowl by the end of the third night, but a few stragglers may persist for several days. It would be advisable for a person introducing new stock into his mite-free flock to use a little caution if he would avoid an infestation.

The author would suggest that new stock not known to be free of mites be allowed to roost the first few nights on a new roost wrapped with pieces of folded paper, preferably black. The object of using the paper is to furnish a convenient place for mites to hide. The paper may be examined, and if mites are found the fowls should be kept on this roost five or six days, or until no more mites come off of the fowls. If mites are discovered, by removing and destroying the papers and treating the roost thoroughly with kerosene or crude oil any danger of the mites getting back on the fowls can be avoided.

The ease with which mites reach the host has a decided bearing on the rapidity of increase. Hungry mites, though placed quite near a fowl, have great difficulty in finding the host unless the means of access is direct. This fact would account for the mite preferring to hide on the roost. When mites are found all over the walls the infestation must be a heavy one. To apply the above facts to aid in control work, the roosts should not be connected up with the walls of the chicken house unless some method of preventing the access of the mite to its host is used. The same may be said of the nests. The simpler and more isolated the roosts and nests, the easier it will be to eradicate the mite. (For control measures see Farmers' Bulletin 801.)

HIDING HABITS.

The direct rays of the sun act as a powerful killing agent when mites are exposed to them. Mites put on a board in the direct sun (July) were killed in a few seconds. Need of a suitable dark, pro-

tected place for deposition and molting governs the hiding habits of the mite. This may be a crack in a board or only a rough place, or it may be in the dry manure or litter. Here a place for deposition, molting, mating, and resting is provided. A very common hiding place for mites is near the nails that hold the roosts to their supports. When the mites become abundant they will overrun the roost and may be found anywhere in the chicken house. Their presence about a house may be detected by the minute black and white spots (excrement) left on the roosts. (See Plate I.) In the spring, when the weather becomes warm, mites come out of their hiding places in great numbers and, not having fed for perhaps a month, run about as tiny gray specks in ravenous haste seeking food. At this season the poultryman can tell easily whether his poultry or coops are infested with mites. A little later, in the case of light infestations, the mites may seem to disappear, but a careful search will show that they have had a feeding of blood and are hiding to reproduce. From now on they come out, perhaps only a few at a time, every night as long as the weather is sufficiently warm. It is important to clear away all manure and trash before trying to kill the mite by spraying with insecticides and to have a roost which may be removed easily, so that the underside may be sprayed.

PASSING THE WINTER.

For the mite the winter season is merely a time of lessened activity. During warm spells and in artificially heated houses the mite will feed if fowls are in reach. Since the mite may live at least four or five months, as shown by longevity experiments, there is no chance in the Southern States of cold weather lasting so long that the mite will starve from this cause. Low temperatures may kill the weaker individuals but do not destroy those with more vitality.

ENEMIES.

A small black ant (*Monomorium minimum* Buckley) has been seen to carry away recently-fed mites. Other species, notably the fire ant (*Solenopsis geminata* Fab.), destroy many. Certain spiders also have been seen to attack and destroy mites. Whether or not ants and spiders are of much importance in this respect is not definitely known. The author has found, however, that some infestations which were not quite killed out by spraying seemed to be exterminated by natural enemies.

DISPERSION.

Mites may be spread in the following ways:

(1) By infested fowls transferred to clean localities.

(2) By the use of boxes and crates in which infested fowls have been kept.

(3) Through the carrying by man of mites on his clothing, thereby starting an infestation.

(4) Through the carrying of mites by sparrows, and probably by pigeons, from one place to another in their feathers.

(5) By horses, cattle, dogs and cats, and certain wild animals, such as foxes, skunks, and weasels, which possibly act as mechanical carriers.

(6) By migration of the mites to buildings in contact or close proximity to infested premises.

The most important method of spread, without doubt, is by infested fowls. In general, it may be said that any carrier may become of greater or less importance, depending upon its closeness of association with an infestation and the degree of the infestation. Also, the danger of infestation increases the nearer clean fowls are located to infested ones.

OTHER HOSTS.

The writer has had thousands of mites crawling on his skin but has no knowledge of having been bitten by any of them; the feeling produced by the crawling mites, however, is very disagreeable. Other people testify that the mite bites them. While turkeys are attacked freely, chickens are favored, and other poultry (pigeons) are fed upon. Stock in barns abutting on chicken houses are at least irritated by mites.

FOOD OTHER THAN BLOOD.

Does the mite feed on anything besides blood? Inasmuch as a number of writers have said that the mite feeds on filth of different sorts, a few experiments were undertaken to get some evidence on the question.

Mites in different stages were put with moist and dry hen droppings, and with feed such as cornmeal and bran, and were watched closely for several days. Mites were then tried with white of egg and yolk of egg; a small quantity being put in a tube with about 50 mites. The mites did not appear to feed, nor, after several days, did they look as if they had fed on any of these substances. Mites were put in a vessel with a partially dried egg but did not appear to feed on it. Mites with access to filth, dirt, etc., lived no longer than mites without access to these substances, and they did not breed in this material.

Inasmuch as the mouth parts of the mite are fitted for piercing and sucking, a fresh egg was cracked so as to expose the amnion, to see if the mite would be able to draw nourishment from it. Careful

measurements were made before and after the chance to feed on egg was offered the mites, but there was practically no change except in the case of one female which increased in length 71.75 microns and in width 100.45 microns. Some of the same mites which refused to feed on the cracked egg fed on a fowl when the chance was given them. The experiment indicates that mites rarely take nourishment in this way.

CONDITIONS FAVORABLE FOR PROPAGATION OF MITES.

The two conditions most favorable for the propagation of mites are (1) frequent direct and easy access to the fowls, and (2) numerous hiding places, such as a complicated roost, dirt, litter, etc. Other favorable conditions are the allowing of dirt and refuse to collect without removal for several weeks. Darkness and dampness without doubt help the mite to live longer in the absence of food. Even under the most sanitary conditions it is able to increase and multiply, so that cleanliness alone is not sufficient to rid premises of the mite, although it is one of the first things to be sought when an attempt at extermination is made because of the greater effectiveness of insecticides when applied.

SUMMARY OF LIFE HISTORY.

Blood is the necessary food of the mite in all stages except the larva, in which stage no food is taken.

It takes about one-half hour to one hour for the mite to get its full feeding and leave the fowl. The mite ordinarily crawls off the fowl onto the roost or other near-by place, where it finds a convenient crack or crevice in which oviposition, molting, and mating take place. Females deposit an average of four eggs each at the rate of four eggs in 24 hours. After finishing deposition the females feed again, usually at night, one engorgement nearly always being sufficient for each deposition. When full of blood the female is elliptical in outline, plump, and blood red (see fig. 2). Females will continue to feed and deposit eight times at least, and possibly many more times. The female must copulate at least once before she will deposit fertile eggs, although fertilization is not necessary before each deposition. The male does not feed immediately upon molting as does the female, but stays in the cracks, no doubt to fertilize several females. The proportion of males to females is about one to two. The eggs hatch in two days (August). The larvæ, which have only three pairs of legs, molt without feeding in about one day. The first meal is taken as a first-stage nymph. The first-stage nymph before feeding is light colored, like the larva, but is much more active. It becomes engorged

with blood once and is ready to molt. One and one-half days is the length of time required by this stage. The second-stage nymph before feeding is rather grayish and, like the preceding stage, is active. With one meal of blood and a molt the second-stage nymph becomes adult. The second-stage nymph, when fed, appears much like the adult (see fig. 2), but smaller. All stages after feeding are blood red. One and one-half days is required to bring the second-stage nymph to the adult. Unfed females are slightly larger than unfed males. Mites that do not get a chance to feed may live four or five months.

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